United States Naval Academy
Mechanical Engineering Department

EM362 Reactor Physics I

Catalog Description: EM362 Reactor Physics I **Credit:** 3 (3-0-3)

An introductory course in nuclear reactors covering radioactivity, fission, neutron diffusion, material and geometric buckling, and the critical equation. Bare and reflected homogeneous reactors are studied.

Prerequisites: Differential Equations

Corequisites: none

Textbooks: Glasstone and Sesonske, *Nuclear Reactor Engineering, 4th Edition, Volume One*, Chapman and Hall, 1994

Course Director: Professor Harper

Objectives[1]:

1. To give the student an introduction to nuclear energy, with an emphasis on radioactivity, nuclear reactors, fission, and the social purposes of nuclear power.

Course Content:

No.	Topic or Subtopic	hrs.
1	Nuclear energy fundamentals	1
2	Binding Energy and nuclear stability	2
3	Radioactive decay mechanisms, calculations	4
4	Types of radioactivity: alphas, betas, gammas, neutrons	3
5	Nuclear fission/critical mass	3
6	Neutron interactions and cross sections	6
7	Fission product activity	2
8	Neutron diffusion theory	8
9	Critical equation	2
10	Slowing down theory	4
11	Four factor formula	2
12	Criticality, two-group theory	2
13	Power reactors	1

Evaluation:

1. Quizzes
2. Homeworks
3. Exams

Acquired Abilities[2]:

1.1 Students will demonstrate knowledge of atomic and nuclear structures, including scientific annotation (1,2,3)
1.2 Students will demonstrate the ability to calculate binding energy and separation energy of the last neutron (1,2,3)
1.3 Students will demonstrate the ability to mathematically describe and quantify different types of radioactivity, including alpha, beta, gamma, and neutron radiation (1,2,3)
1.4 Students will be able to describe the fission process (1,2,3)
1.5 Students will demonstrate the ability to look up and use cross sections for calculations (1,2,3)
1.6 Students will demonstrate the ability to write and solve the neutron diffusion equation for infinite and finite, non-multiplying as well as multiplying homogeneous media (1,2,3)
1.7 Students will demonstrate the ability to calculate key parameters for neutron slowing down, including average collisions to thermalize, scattering angle, and moderator effectiveness (1,2,3)
1.8 Students will demonstrate the ability to set up and solve the 1-group and 2-group critical equations (1,2,3)
1.9 Students will demonstrate the ability to use the four factor formula in solving the reactor equation for various reactor materials and geometries (1,2,3)

Date of Latest Revision: 6 November 2001

[1] Letters in parenthesis refer to the Program Objectives of the Mechanical Engineering Program.
[2] Numbers in parenthesis refer to the evaluation methods used to assess student performance.